Joint Attention and Social Imitation Skills In Children with Autism Spectrum Disorder

Research Thesis

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by

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Abstract

This paper examined the relationship between joint attention and social imitation and the impact of joint attention in therapy designed to target the social imitation deficits in children with autism spectrum disorder. Much of past research relied on third variables to develop the nonverbal communication deficits. This study acknowledged past limitations and focused on the importance of joint attention as a foundational skill to develop social imitation. A scale measuring nonverbal communication skills was used to predict change in imitation skills of children who completed 10 weeks of intervention, measured by two separate imitation assessments pre- and post-therapy. Results found proximal response to joint attention bids to be statistically significant predictors for imitation growth in the MIS and UIA-O, along with age and pre-therapy imitation scores on the specified assessment. The reciprocal relationship between joint attention and imitation in a therapy setting was discussed as a future direction. Overall, this study provided evidence for the importance of joint attention in the hierarchy of communication skills and its role as a possible influence future participant inclusion criteria of imitation therapies.

Key Words: *joint attention; social imitation; autism spectrum disorder*

Importance

Autism spectrum disorder (ASD) is a developmental disorder that is mainly characterized by communication problems and repetitive movements or behaviors, according to the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (American Psychiatric Association, 2013). ASD can also be classified by social difficulty pertaining to either people or events and affects roughly 1 out of every 68 people (Centers for Disease Control and Prevention, 2016). The cause of ASD is not clearly defined; however, it is known that a combination of genetic and environmental factors contribute to this social disorder (American Psychiatric Association, 2013). These neurological and biological components associated with ASD create signs that are detectable in early childhood.

With such a presence in today's society, it is imperative to comprehend the influence ASD has on daily function. People with ASD demonstrate stress (Miller & Seligman, 1975) and fear (Maier & Watkins, 1998) in uncontrollable social situations. In these unexpected social situations, people with ASD will typically withdraw themselves from that anxiety-inducing situation. This withdrawal creates a feedback loop where learned helplessness and peer rejection progress into further communication problems (Seligman, 1975). In other words, children with ASD are discouraged from participating with typical-developing peers in social situations and are taught that they are not capable of such interactions. This dismissal is carried throughout adulthood and translates to a lack of social opportunity for communication skills to mature.

Training people with ASD in nonverbal communication skills—such as joint attention, which involves two people shifting their attention to simultaneously focus on the same object or event—has the potential to reduce their situational learned helplessness (Koegel & Mentis, 1985) and allow them to become familiarized with communicative imitation. Such therapy aims to

teach fundamental communication and social skills. When given building blocks for social skills, such as imitating play with peers, people with ASD have increased opportunities to engage in social interaction and further develop their social and communication skills.

Literature Review

Imitation is a key social factor that can be organized into different categories. Ingersoll (2008) claims imitation can be utilized as a learning function, where new skills and knowledge are acquired by an infant, and as a social function, which involves social engagement and emotional exchanges. To elaborate, learning to shoot a basketball by copying someone would exhibit the learning function of imitation. A social function of imitation would be mimicking someone's body language during a conversation to convey empathy.

In regard of social aspect, nonverbal communication with a peer is a strong elicitor of future social interest. Two people who see someone trip on the sidewalk may exchange shocked expressions, as to both nonverbally comment on the awkward situation. This social interaction can be used to further develop social relationships with peers. For example, early interactions with caregivers are often characterized by imitations of the other's vocalizations and facial expressions. By the end of an infant's first year, play becomes object focused and object imitation arises (Uzgiris, 1990). Gesture imitation typically emerges during the second year with interests and engagement expressed through reciprocal imitation (Waxler & Yarrow, 1975).

Reciprocal imitation, or the response to someone's action by mimicking, is a key component of early peer interactions and remains a strong predictor of social interest throughout childhood. Playing with a shared toy can initiate interaction—and if maintained, additional imitation beyond the first instance—between toddlers (Eckerman & Stein, 1990). Before verbal communication develops, sustained reciprocal imitation allows for social interaction amongst

toddlers of the same age. These basic imitation exchanges express a common understanding of the interaction and mature other play skills (Eckerman, 1993). Overall, the social use of imitation is related to the development of complex communication skills.

In addition to this theoretical basis for the importance of imitation, past research has also indicated that imitation skills are associated with other important social communication skills. Pertaining to language, Dawson and Adams (1984) found that people with ASD that were classified as high imitators verbalized more often. Moreover, imitation is found to be a precursor to language acquisition and verbal communication (Sigman & Ungerer, 1984). Furthermore, research found that deficits in verbal imitation resulted in expressive language delays, while deficits in gestural imitation lead to issues with receptive language, such as commands (Ingersoll, 2008). Stone and Yoder (2001) also found a strong relationship between motor imitation and language development, especially in children with ASD. However, other researchers (Rogers et al., 2003) did not find as strong of a relationship, if any, which could possibly be due to different measurement methods or confounding variables.

To extend this research, children with ASD are often not good imitators, particularly in social situations. People with ASD experience difficulty imagining themselves in someone else's position due to a lack of behavior observation and processing (Williams, Whiten & Singh, 2004). This lack of social representation formation and coordination has been found to influence imitation, social, communicative, and emotional skills (Stern, 1985). More specifically, body and facial imitation is affected and often predicts speech development (Stone et al., 1997). This imitation deficit is a major component of the social deficits that are present in children with ASD.

One common method of attempting to teach imitation skills to children with ASD is the discrete trial training method. The discrete trial training method is in a structured environment where the examiner uses explicit prompts for the child to copy. However, this method has related limitations, including the lack of an environment representable of situations in the real world. In this method, imitation is traditionally used as a learning skill, so it is not capable to build social communication skills (Ingersoll, 2008). As a learning skill, explicit prompting is needed for a response, and that response is contingent on reinforcement, leaving no room for spontaneous imitation (Carr, 1981). Similarly, the structure and reinforcement dependency limit the generalizability of the imitation results to other environments (Lovaas, 1977). An isolated environment is unnatural when compared to both adult-child interactions (Schreibman, Koneko & Koegel, 1991) and peer-child interactions. Imitation is involved in various developmental roles, generating a need to increase applicability.

To combat the lack of generalizability and social use of imitation in discrete trial approaches for children with ASD, a method called reciprocal imitation training (RIT) has emerged. Ingersoll (2008) defined RIT as "a naturalistic intervention designed to teach the social use of imitation to young children with autism during play" (111). The goal of RIT is to teach imitation skills within continuous social interaction. Due to the influence of the naturalistic behavioral model, intervention with RIT follows the child's lead until a prompt is presented by the therapist. A real-world environment is maintained with the use of reinforcing attempts after a failure and natural reinforcement, typically through verbal praise.

Remaining Questions

It is important to note that as the above literature demonstrates, an increasing amount of research is being conducted to examine the effects of nonverbal communication on language

acquisition and the effects of social imitation on language acquisition, but not the direct effects of nonverbal communication on social imitation. Although improvements to language perception and comprehension carry great importance to the development of language skills (Rogers et al., 2003), the relationship between nonverbal communication and imitation factors can be crucial to producing the most beneficial intervention therapy for children with ASD. Due to both the variability in such a vast population and the range of known social deficits, one type of therapy may work well for one group of children with ASD, while a different therapy works best for others. It is critical to fully understand how social skills work together to impact someone's life.

When looking at the big picture, people with ASD experience deficits in their social capabilities. More specifically, both nonverbal and social communication skills are affected with this disorder (Ingersoll, 2008). To develop the social function of imitation, steps must be taken to draw attention to the act that is to be imitated. This focus and redirection of attention requires the use of joint attention. In other words, joint attention can be considered a prerequisite or foundation to social imitation development, which was the concentration of this study.

When engaging in joint attention, the child sees the examiner interact with the object as well. The child sees the examiner imitating his or her own interactions with the toy; therefore, the child has the foundation to imitate the examiner's actions. These imitations revolving around a common object can then be generalized to other social situations. In general, joint attention allows people with ASD to focus their attention on the current event or action. This attentiveness is necessary for communicative imitation to be introduced because watching and engaging in a conversation first requires one's joint attention.

Present Research

To acknowledge these pressing questions, this research examined whether children diagnosed with ASD that possess more advanced joint attention skills, when compared to other children with ASD, would show greater improvement with social imitation skill development following ten weeks of twice-weekly Reciprocal Imitation Training (RIT) sessions. More specifically, it was thought that better response to joint attention during a semi-structured assessment, *Early Social Communication Scales* would be associated with greater gains in object imitation, as measured by the *Motor Imitation Scale* and *Unstructured Imitation Assessment*. The results of this study helped to determine how joint attention and social imitation relate to one another. Further, this study can help the researchers and clinicians make decisions regarding which children with ASD may benefit most from Reciprocal Imitation Training.

Design

This study used a longitudinal correlational design to examine the influence of response to joint attention on gains in imitation following 10 weeks of twice-weekly RIT treatment. The baseline data was collected from a one-month period before the intervention began. Following the collection of baseline data, each participant received 10 weeks of therapy, with two therapy sessions per week, for a total of 20 sessions over the course of therapy. Post-treatment data was collected within two weeks following completion of treatment.

Participants

Recruitment

Participants for this study were children who completed participation in an ongoing study examining the effectiveness of parent versus therapist-administered RIT. These participants were identified through the Nisonger Center's research database and recruited from community programs, including schools and organizations that benefit the families of children with, or

considered at-risk for, ASD. Participants received The Autism Diagnostic Observation Schedule, 2nd Edition (ADOS-2) at intake to confirm any diagnosis of ASD. This study had complete data for all nine participants of the ongoing study (two female, seven male; mean age of 38.22 months).

Inclusion Criteria for Participants

The following inclusion criteria was applied to determine participant eligibility in the study:

1. Participant was under 60 months of age at the start of the study.
2. Participant obtained a score below ceiling on imitation performance at baseline assessment.
3. Child met criteria for "autism" or "autism spectrum" on the ADOS-2.

Attrition

Two families withdrew from the study before completing post-therapy assessments, so the child's data was not included in analyses.

Measures

Several assessments were conducted at the initial appointment to establish baseline measures used to characterize the subject and variables for the study:

Subject Characterization Variables

Demographic information completed by the parent or caregiver and scores from the following exams provided background knowledge and classification of the child.

Mullen Scales of Early Learning (Mullen). The Mullen is a quick and reliable assessment often used to measure cognitive ability and motor development in children from birth to five years of age. The five domains tested in the Mullen are gross motor, fine motor,

expressive language, receptive language, and visual reception. The assessment scores identify the strengths and weaknesses of a child and provides a foundation for future interventions (Mullen, 1995).

Autism Diagnostic Observation Schedule- Second Edition (ADOS-2). The ADOS-2 is a semi-structured assessment of communication, social interaction and play for subjects at varying skill levels. The examiner observes the child's behavior and introduces "presses" of planned social situations to look for a particular behavior characteristic of ASD (Murray, 1938).

Predictor Variables

Early Social Communication Scales (ESCS). Developed by the MIND Institute at the University of California at Davis, the ESCS measures individual differences in nonverbal communication skills in children under three years of age or verbal capacity typical for that range. The examiner prompts social actions with a controlled set of toys to elicit possible social responses. The environment is relaxed, as the test revolves around play-based interaction but is administered at a table.

The ESCS was administered at both the pre- and post-therapy time points. It was scored using Mangold INTERACT software with a schema designed for researchers to classify the child's behavior into three separate social-communication behaviors: social interaction, behavioral requests, and joint attention—simultaneous attention on a common object between the child and the examiner. These behaviors are also classified based on whether the behavior is initiated by the child or acts as a response to a prompt. For example, eye contact from the child can initiate joint attention on an object, initiate a behavioral response from the examiner to complete a desired action, or display a response to an action by the examiner (Mundy et al., 2003).

For the purpose of this study, we focused on the response to joint attention variable from the ESCS. This variable was administered by the examiner pointing at posters on the wall (eight times) or at pictures in a book (six times). To be scored as a success, the participant needed to shift their attention in response to the examiner's pointing gesture and focus on the object the examiner is pointing to (see Figures 1 and 2). A child's shortened gaze that did not extend past the examiner's finger did not count as response to joint attention due to the lack of attention on the common object. The two response to joint attention variables, proximal (book) and distal (poster), were scored separately as total percentage of correct responses for each variable.

Outcome Variables

Motor Imitation Scale (MIS). The MIS was administered to the child by researchers to evaluate imitation of 16 actions. The participant was expected to stay seated at the table, but the examiner could manipulate tasks or the order of the exam to accommodate the child. Eight items on the scale were designed to test object imitation and eight for gesture imitation. Researchers scored the imitation items from recordings of the session on a scale of zero to two—with a two meaning the participant fully completed the imitation prompt, a one meaning the child's response was emerging, and a zero meaning the participant failed to imitate the examiner. The MIS was administered at both pre- and post-treatment, while the total score, ranging from 0 to 32, was used in all analyses. Coders were provided guidelines to distinguish responses between scoring categories (Stone et al., 1997).

Unstructured Imitation Assessment-Object (UIA-O). The UIA-O evaluates object imitation skills in an environment with little structure. The examiner uses pairs of toys to imitate the child's behavior and then models a new play action three times, while giving the child the opportunity to imitate. No specific direction to imitate is given. The object assessment is

composed of 10 imitation items; recordings of the sessions were used to score the UIA-O (McDuffie et al., 2007). Similar to the MIS, the UIA-O scores items from zero to two with the same distinctions as above with guidelines provided to define the scoring categories. The difference score from pre- to post-therapy was used as an outcome variable.

Therapy

Intervention. Researchers administered reciprocal imitation training (RIT) to participants two times a week for the duration of 10 weeks. The participants either received two, hour-long RIT sessions by trained research assistants each week or one RIT session by trained research assistants and one parent-training session each week, in which the parent received instruction on how to implement RIT in the home environment.

The environment of RIT was very play- and child-focused (see Figure 3). Each session began with the therapist mimicking the child's actions. The therapist then modeled a play action that they wish the child to imitate, using a toy that interests the child. The child had three attempts to spontaneously imitate modeled actions. However, if the child failed to independently imitate the prompt, the therapist provided hand-over-hand guidance to complete the said prompt. The child received verbal praise, whether the action was completed spontaneously or with guidance, and both the child and examiner returned back to the child-focused play. This social prompt was to occur roughly once per one to two minutes, equaling 5 to 10 prompts completed within the first half of each 20-minute RIT session (Ingersoll, 2008). For the purpose of this study, the direct therapy and parent training groups were collapsed.

Inter-rater reliability. Research assistants were trained to accurately score the assessments used in this study. The MIS and UIA-O were scored by a paper-and-pencil method, while the ESCS results were scored with assistance from Mangold INTERACT video coding

software. Coding was compared amongst the trained researchers to obtain at least 80 percent reliability prior to the scoring of videos. Roughly 30 percent of the ESCS videos were scored by a second rater to calculate an inter-observer agreement over 90 percent.

Analysis

Ordinary least squares (OLS) regression was used to predict change from pre- to post-treatment on the MIS and UIA-O. Child age, Mullen score, ADOS-2 severity score, and imitation scores at time one were entered in the first step. Then, the proximal or distal response to joint attention score was entered in a second step. Due to the fact Mullen, ADOS-2, and age were correlated and generally did not show strong relationships with change in imitation over time across the models, Mullen score and ADOS-2 severity were dropped from the final models. The final models included child age and imitation score at time one in regression step one and either proximal or distal response to joint attention in regression Step 2.

Aims and Hypotheses

Primary Aim

We examined whether better response to joint attention at baseline was associated with greater imitation improvement, defined as increased completed imitation prompts on the MIS and UIA-O.

Hypothesis

We hypothesized that children with ASD that possess more advanced response to joint attention skills would show greater improvement in social imitation over the course of a ten-week intervention period.

Results

Participant Characteristics

See Table 1 for additional data for participant variables. Data was analyzed for a total of nine participants (two female, seven male) who completed the intervention and post-therapy examinations. The ages of the subjects ranged from 25 months to 52 months with an average age of 38.22 months and a standard deviation of 9.72 months. The average Mullen standard score was 53.11 with a standard deviation of 6.68. This score falls in the "very low" range of cognitive ability. To confirm an ASD diagnosis and distinguish severity, the ADOS was conducted on all participants, resulting in a mean calibrated severity score of 7.78 with a standard deviation of 1.72. The calibrated severity score in the ADOS accounts for age, verbal level, and test version and converts standard scores into a severity score to compare children to the ASD qualifications in an easier, standardized manner, using a scale from 1 to 10 with a higher score indicating a more severe case of ASD.

Descriptive Statistics

See Table 1 for additional data for descriptive statistics. Using the ESCS, the average proximal response to joint attention scored 67.89% with a standard deviation of 30.89%; while the average distal score was 37.67% with a standard deviation of 32.38%. The MIS and the UIA-O were conducted in a larger group of assessments before and after therapy to measure any change in examination scores. Change in MIS scores ranged from -3 to 22 and had an average change of 4.11 with a standard deviation of 8.25. Similar to the response to joint attention data, change in the UIA-O was conducted and analyzed. The mean change in the UIA-O scores was 2 with a standard deviation of 6.08.

Linear Regressions

Regression on MIS.

Proximal Response to Joint Attention. Age and pre-therapy MIS score were entered into regression in the first step, and proximal response to joint attention was entered in a second step. The regression model was significant after the second step, $F(3, 5) = 18.983$, $p = .004$, R^2 *change* = .829. Among the covariates, both age and pre-therapy MIS imitation scores were significant predictors of change in the MIS. Age and pre-therapy MIS imitation scores both had negative β values of -.797 and -.669, respectively (both with $p<.01$). Proximal response to joint attention was also a significant predictor of change in the MIS with $\beta = 1.126$, $p = .001$.

Distal Response to Joint Attention. Age and pre-therapy MIS score were again entered into the regression at Step 1, with distal response to joint attention entered in a second step. Entering distal response to joint attention did not significantly improve model fit, and the final regression model did not significantly predict change in MIS score, $F(3, 5) = .257$, $p = .854$, R^2 *change* = .043. None of the individual predictors in the regression model were significantly associated with MIS change. See Figure 4.

Regression on UIA-O.

Proximal Response to Joint Attention. Age and pre-therapy UIA-O score were entered into regression in the first step, and proximal response to joint attention was entered in a second step. The regression model was significant after the second step, $F(3, 5) = 12.096$, $p = .01$, R^2 *change* = .802. Among the covariates, both age and pre-therapy UIA-O imitation scores were significant predictors of change in the UIA-O. Age and pre-therapy UIA-O imitation scores both had negative β of -.666 ($p<.05$) and -.842 ($p<.01$), respectively. Proximal response to joint attention was also a significant predictor of change in the UIA-O with $\beta = 1.113$ and $p = .002$.

Distal Response to Joint Attention. Age and pre-therapy score were again entered into the regression in Step 1, with distal response to joint attention entered in a second step. Similar

to the distal bid in the MIS, entering distal response to joint attention did not significantly improve model fit. Likewise, the final regression model did not significantly predict change in UIA-O scores, $F(3, 5) = 1.409$, $p = .343$. None of the individual predictors in the regression model were significantly associated with UIA-O change. See Figure 5.

Discussion

The goal of this research was to determine how joint attention and social imitation relate to one another. Children with higher scores responding to joint attention in the ESCS exhibited more change in imitation after ten weeks of therapy across both the MIS and UIA-O. In other words, children with ASD that entered therapy with better pre-existing joint attention skills were able to make greater gains in therapy targeting social imitation.

The ESCS consisted of two targets for joint attention—the book (proximal), which consisted of six proximal points to pictures in a book by the examiner on the table directly in front of the participant, and the poster (distal), a set of four distal points repeated twice by the examiner to posters on the wall next to and behind the participant. The two versions of response to joint attention were analyzed separately to emphasize the importance of proximity in the development of communication and imitation skills. For both the MIS and UIA-O, response to joint attention for the proximal target was a significant predictor of change in imitation skills, while response to the distal target was not (see Table 2).

The positive, significant β values for the proximal target compared to the non-significant β values for response to joint attention towards the distal target suggests the importance of proximity to the child to change in imitation. For example, with every one standard deviation increase in proximal response to joint attention (~31 percent) there was a 1.126 standard deviation increase in MIS score (~12 points). Furthermore, the proximal target was placed

directly in front of the subject within an arm's reach, resulting in a better chance to notice a slight shift in pointing. On the other hand, the distal bid had targets placed on the walls adjacent and behind the subject with a distance of roughly five feet from the subject. For children with ASD, the proximal task had a higher mean score than the distal task (Table 1); therefore, it can be considered easier than the distal task possibly due to a proximity component.

In addition, response to joint attention towards a proximal target may be a better analog of imitation training because both utilize the toy's placement in front of the participant to seize the participant's attention (see Figure 2). Children with better proximal response to joint attention skills may be better suited to learn imitation during RIT because they are more likely to pay attention to the therapist's model. The model occurs directly in front of the child and only requires a slight shift in attention to notice what the examiner is doing with the toy of interest and ultimately benefit from the prompts during RIT. On the other hand, RIT never requires the participants to shift their attention across the room, which is characteristic of the distal poster responses to joint attention prompt (see Figure 3). Children who imitate more often during RIT sessions may also make greater gains in overall imitation skills, as measured by the results to the post-treatment imitation assessments.

By engaging in joint attention during RIT, growth in imitation was more likely to be seen in social interaction because the reinforcement was utilized in a social setting. There was no explicit prompting or praise; the child was self-motivated to engage in the social interaction to return back to what the child was previously playing with. This concept supported the previous findings of Carr (1981) stating a highly structured and reinforced intervention does not allow for spontaneous imitation and Lovaas (1977) because the response to joint attention skills were able to generalize to RIT. Furthermore, the skill of responding to joint attention towards a distal

object may still be important clinically, but it was not statistically relevant to develop social imitation (although there was a trend toward distal response to joint attention being positively associated with gains in the UIA-O).

Limitations and Future Directions

One noteworthy limit of this study was the small sample size composed of nine children with ASD. This study was run using families within the Columbus area, which may not be representative of the population of children with ASD nationwide. Examining this study with a larger sample size would determine if these results would hold with subjects that are more representative of the overall ASD population. Additionally, fluctuations that could explain individual performance differences, such as a lower post-therapy assessment score, would have less of an impact on the overall average change scores with a larger sample.

Similarly, this study examined children with ASD up to the age of 52 months. These results cannot be generalized to older individuals with ASD—a population that continues to grow. Further research could identify if imitation can be learned later in life or if there is a critical time in development for this skill. Depending on results, therapy can be developed for adults with ASD to improve imitation skills and ultimately nonverbal communication skills.

This study also lacked a control group as every subject was enrolled in the RIT program. The lack of a control group limits how good of a predictor we can claim the covariates to be because this study demonstrated that better response to joint attention skills at baseline predicts more change in imitation. It is not necessarily clear whether this change is because response to joint attention generally promotes growth in imitation regardless of RIT or whether response to joint attention specifically leads to more gains as a result of RIT.

A future direction from this study would be to determine if imitation skills are developed in general with joint attention or if they are dependent on a therapy specifically designed to target imitation. Furthermore, the reciprocal relationship between response to joint attention and imitation in a therapy such as RIT would also need to be examined. The continual shifting of attention to the adult's model is reinforced in RIT by returning back to the child-directed play. Participants that imitate more successfully during RIT may also be gaining additional new response to joint attention skills due to the reinforcing nature of RIT towards successful imitations. By enrolling a larger, more variable sample, the influence of other factors can be determined. Ultimately, this could be implemented into various imitation therapies providing more joint attention and imitation learning opportunities based on pre-therapy imitation skills. However, this explanation is theoretical and additional research would need to be conducted to support this claim.

Clinical Implications

Furthermore, this study provided evidence to support the hypothesis stating joint attention was a necessary precursor to social imitation. While other therapies are designed to alleviate nonverbal communication deficits in children with ASD, this research alluded to the idea that children with ASD who first develop joint attention skills may be more likely to advance in nonverbal communication intervention. This supported the research of Stern et al. (1997) claiming body and facial imitation predict verbal communication because the ability to shift one's attention from a toy to a face would be necessary for further imitation. The hierarchy of communication has particularly been examined to further detail the order of essential communication components (Carpenter, Pennington & Rogers, 2002).

Subsequently, our significant results of the role of response to joint attention in the development of social imitation skills supported the research of Ingersoll (2008) and could contribute to participant inclusion criteria for RIT. With these results, more specific enrollment criteria and participant characterization variables could be included in therapy pre-screening to better suit the needs and abilities of children with ASD. ASD is a spectrum, so idiosyncrasies displayed in one participant may not be present in another. By understanding the need for joint attention to succeed imitation therapy (RIT in this case) and creating a better fit in a relevant therapy, time wasted on failed interventions could be allocated to a therapy designed to target the next step of nonverbal communication.

Conclusions

Overall, this study gave rise to important results pertaining to the nonverbal communication deficits characteristic of children with ASD. This study emphasized the importance of joint attention to develop imitation skills. By contributing to the order of social communication acquisition, joint attention skills that develop into imitation skills have a stronger influence on language development (Sigman & Ungerer, 1984; Stone and Yoder, 2001).

Both nonverbal and social communication skills are affected in ASD (Ingersoll, 2008) and this study provided evidence that attention must be redirected to the target of imitation to develop the social function of imitation. Exchanges in joint attention and imitation ultimately create a common understanding of social interaction (Eckerman, 1993). Results from this study emphasized the importance of proximity when having to shift attention. Proximity has not explicitly been discussed concerning joint attention and imitation in past literature; however, this study introduced the effect of proximity on verbal imitation and expressive language as well as gestural imitation and receptive language (Ingersoll, 2008).

In general, the results from this study highlighted the need for joint attention in the levels of social communication skills for imitation and later communication skills to develop. With this knowledge, treatments and interventions for ASD could have the ability to be effectively tailored to each individual's goals.

Figures and Tables

Figure 1. Example of the environment during RIT.

Figure 2. Example from the ESCS of the proximal response to joint attention bid.

Figure 3. Example from the ESCS of the distal response to joint attention bid.

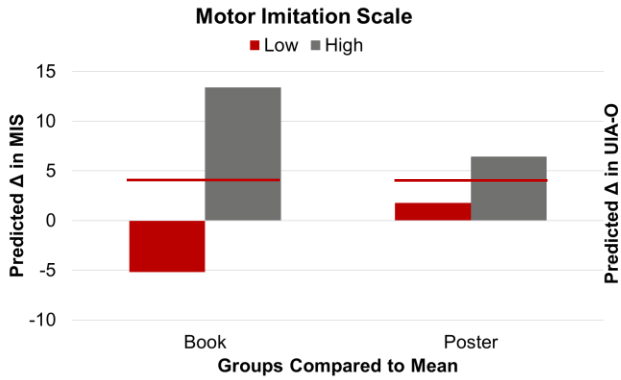

Figure 4. Predicted change for groups one standard deviation above and below the mean score in the MIS for the proximal and distal tasks.

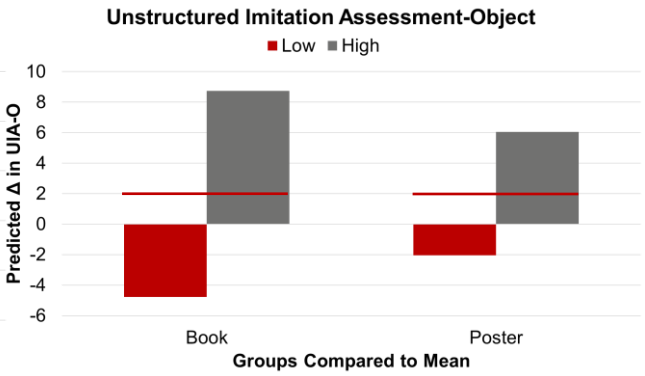

Figure 5. Predicted change for groups one standard deviation above and below the mean score in the UIA-O for the proximal and distal tasks.

Table 1

Participant Characteristics

	Statistics		
Covariates	**Mean**	**SD[a]**	**Range**
Age[b]	38.22	9.72	25–52
ADOS-2 Score	7.78	1.72	6–10
Mullen Score	53.11	6.68	49–68
Pre-Therapy MIS	9.56	7.92	4–30
Post-Therapy MIS	13.67	10.90	3–31
Pre-Therapy UIA-O	5.22	3.53	0–10
Post-Therapy UIA-O	7.22	6.14	0–18
RJA Proximal[c]	67.89	30.89	25–100
RJA Distal[c]	37.67	32.38	0–100

[a] Standard Deviation; [b] Measured in months; [c] Percent followed in response to joint attention task for specified target

N = 9

ADOS Score = Autism Diagnostic Observation Schedule, Second Edition; Mullen Score= Mullen Scales of Early Learning; Imitation Score = raw score for specified imitation assessment; RJA = response to joint attention

Table 2

Linear Regressions Predicting Change in Imitation

	Motor Imitation Scale[a]				Unstructured Imitation Assessment-Object[b]			
	Proximal		Distal		Proximal		Distal	
Predictor Variable	**R^2**	**β**	**R^2**	**β**	**R^2**	**β**	**R^2**	**β**
Overall Model	.829	*F* (3, 5)=18.983**	.043	*F* (3, 5)=.257	.802	*F* (3, 5)=12.096**	.381	*F* (3, 5)=1.409
Age		-.797**		-.290		-.666*		-.075
Pre-Therapy MIS		-.669**		-.336		--		--
Pre-Therapy UIA-O		--		--		-.842**		-.537
RJA Proximal		1.126**		--		1.113**		--
RJA Distal		--		.283		--		.664

[a] Raw score on Motor Imitation Scale; [b] Raw score on Unstructured Imitation Assessment-Object;

*$p < .05$; **$p < .01$

ADOS Score = Autism Diagnostic Observation Schedule, Second Edition; Mullen Score= Mullen Scales of Early Learning; RJA = response to joint attention

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